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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the
Committee on Science and Astronautics
House of Representatives

Mr. Chairman and Members of the Committee:

NASA's approach to the conduct and management of its space and aeronautics program relies on the capabilities of government, industry, and university organizations. In implementing this approach, NASA has utilized the scientific, engineering and management competence of its inhouse laboratories to manage its complex research, development and flight missions and to work with other government agencies, industry and universities in ways that strengthen these institutions and, thereby, increase our national well-being and strength.

The contributions of these various organizations to NASA's program and their capabilities are apparent in the rockets and space flight systems that have been built by industry, in the large number of flight experiments and space science reports prepared by university scientists, and in the results of our inhouse research and the planning and management

of even the most complex of our space missions -- Apollo -- by our inhouse scientists, engineers and managers.

Because of the importance of this inhouse capability to the successful accomplishment of our programs, because it requires a large part of our total budget request, and because no one of the Subcommittees reviews the overall resources required to support this inhouse capability, we believe it necessary to describe to the full Committee the full Research and Program Management budget which is the new and more accurate and descriptive title given to the Administrative Operations budget of prior years. I will then summarize briefly the work NASA is doing with universities in both its project activities and in the Sustaining University Program for which we are requesting new obligational authority of \$9 million in the budget before you. And, finally, I will briefly review some of the recent activities and plans for the Technology Utilization Program which provides for the identification and dissemination of knowledge acquired in our aeronautics and space activities that may have applicability to other parts of our national economy. We are requesting \$5 million for this part of our program.

The Research and Program Management budget request for Fiscal Year 1970 is \$650.9 million. Although this dollar amount is about \$2.6 million higher than our Fiscal Year 1969 operating budget, the Fiscal Year 1970 request continues the reduction in our civil service manpower that started in 1967 and continues the austere operating levels established during Fiscal Years 1968 and 1969.

Seventy-two percent of our Fiscal Year 1970 request in this Research and Program Management appropriation covers the salaries and benefits of all NASA civil service personnel and civilian and military personnel detailed to NASA by other government agencies; it includes the salaries of the scientists, engineers, and supporting technicians that make up 70% of the total NASA civil service work force.

This appropriation also covers the direct expenses of operating our laboratories -- our research centers (Lewis, Langley, Ames, Flight and Electronics Research Centers), our development centers (Marshall and Goddard Space Flight Centers and the Manned Spacecraft Center in Houston), and the launch centers (Kennedy and Wallops Space Centers). This appropriation provides funds for maintenance and operation of our facilities at these centers. It supports the development and installation and operation of our general purpose computer capability and the logistics support and administrative support required in these centers.

Thus, this appropriation provides funds for the government's scientific, engineering and management manpower within NASA to plan, review, and make major decisions on the work to be done at government expense. It provides funds to operate the NASA laboratories, which have been established as the government's technical and management interface for contract activities to work with our contractors in anticipating problems, in applying the results of our inhouse research work for the solution of the problems and the definition of improved research, hardware, and mission concepts. We have, therefore, renamed this part of our budget as the Research and Program Management appropriation to reflect more accurately and fully the work it supports. This is not an administrative

overhead account as many feel was implied by the Administrative Operations title used in previous years.

The Fiscal Year 1970 Research and Program Management budget request of \$650.9 million has been developed on the basis of continuing the economies achieved in the past several years and in recognition of the expressed intent of the Congress and the President to reduce expenditures to the minimum. These economies are readily apparent from a brief review of our Fiscal Years 1968 and 1969 operations.

In Fiscal Year 1968 we requested \$671.3 million in our budget request. The Congress authorized \$648.2 million and appropriated \$628 million -- a reduction of \$43.3 million from our request. Our operating plan was established within this total dollar level by reducing the employment we had planned by 1,704 permanent civil service positions, and reducing our costs for budget items other than personnel cost by nearly 18%. The only funds transferred to the appropriation were \$12.5 million to cover costs of pay increases under the Federal Salary Act of 1967, which became effective in October 1967.

Near the end of the Fiscal Year 1968, 127 new positions were established for the conversion of certain support contract functions to civil service operations at Goddard Space Flight Center. This conversion was made as a result of the opinion of the Civil Service Commission's General Counsel that operations under these contracts were proscribed by personnel statutes. In addition, the Bureau of the Budget approved the retention of 120 employees as part of our agreement with the Civil Service Commission to permit proceeding with the required reduction-in-force at Marshall Space Flight Center.

After these major adjustments, our final operating budget for Fiscal Year 1968 provided a total of \$639.3 million and reduced our on-board manpower by 1,255.

In Fiscal Year 1969 our budget request was for \$648.2 million. This was developed by retaining the base of \$628 million appropriated in Fiscal Year 1968, increased only enough to cover the \$18.6 million required for the full year cost of the general salary increase which was effective for only part of Fiscal Year 1968 and to cover the \$1.6 million cost of the support service contractor conversions at Goddard. This request was reduced by floor action to \$603.2 million.

The effects of a reduction to \$603.2 million were assessed, and it was considered that such a reduction -- \$45 million -- would have been so disruptive as to make impossible the successful and effective execution of the programs approved by Congress. At the \$603.2 million level, after all other economies were made, it would have been necessary to reduce the planned employment in permanent civil service positions by at least 4,900 positions.

After studying alternative operating levels it was determined that the minimum acceptable operating level was \$623.3 million so \$20.1 million were transferred to the appropriation from our Research and Development appropriation. Even at this level, a reduction of 1,661 positions was required in planned employment and a reduction of more than 10% was made in all costs other than the personnel costs. The operating budget level of \$623.3 million is still significantly less than the

\$646 million recommended by the House Authorization Committee and the \$635 million recommended by the Senate Authorization Committee.

In addition to the reprogramming of \$20.1 million to establish a minimum operating level, two other major adjustments have been made in our Fiscal Year 1969 operating budget. The second increment of the increases in salaries resulting from the Federal Salary Act of 1967 became effective in July 1968. The estimated cost of the increase was not included in the NASA budget request, since the entire government-wide cost was included in the President's budget without distribution by agency. The cost of this increase -- \$23.7 million -- was provided by transferring to the Research and Program Management appropriation, funds withheld by the Bureau of the Budget from NASA's Research and Development appropriation. The other major increase results from additional conversions to civil service operation of certain support service functions being carried out under contract at Goddard. These conversions are being made as a result of detailed studies which established that certain contracts were similar to those the Civil Service Commission held were proscribed by personnel statutes. Therefore, 810 additional civil service positions have been planned to carry out these functions -- 559 in Fiscal Year 1969 and an additional 251 are included in Fiscal Year 1970 to complete the conversion.

Early in May 1968, when it became apparent from pending legislation that the Fiscal Year 1969 operating plan would be significantly below our request, action was taken to restrict employment prior to the end

of FY 1968 in order to avoid large and disruptive reductions in personnel after the beginning of Fiscal Year 1969. As a result of these actions, the on-board manpower complement is being reduced by 1,285 in Fiscal Year 1969 and 559 new positions are being established at Goddard for support service operations.

From our highest civil service employment level of 34,126 in July 1967, the number of NASA's permanent employees will have decreased by 2,526 to 31,600 at the end of Fiscal Year 1970. During this same period, 965 positions will have been established specifically to convert certain support service functions carried out under contract with industry to civil service operations. This results in an effective decrease in manpower of 3,491, with a reduction from our planned manpower of 4,374.

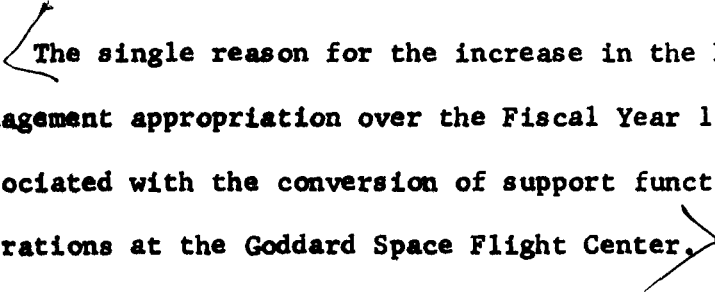
We are planning all of these reductions in personnel by attrition -- not refilling all positions that become vacant as employees leave. This is becoming increasingly difficult since the rate of separations has slowed appreciably and the separation rate is not the same in all skill and discipline groups. The overall separation rate during the current year is only about two-thirds of the rate for Fiscal Year 1968.

It should be noted that we are required to forfeit 30% of our vacancies resulting from resignation, retirement, removal or death under the directive established by the Director of the Bureau of the Budget implementing the requirements of Section 201 of the Revenue and Expenditure Control Act of 1968. The 559 positions established this

Fiscal Year for conversion of the contracted functions at Goddard must be accommodated within the refillable vacancies allowed under the provisions of Section 201. Therefore, before these new functions can be taken on at Goddard, we must reduce our actual employment at a rate more than twice as great as is required by the tax bill and the BOB implementing directive.

To provide further understanding of the requirements included in our Fiscal Year 1970 Research and Program Management Budget request, I will now discuss each of the major cost categories listed below:

	<u>1968</u>	<u>1969</u>	<u>1970</u>	Change in <u>FY 1970</u>
Personnel related costs	\$432.3	\$463.7	\$469.5	\$+5.8
Travel	15.1	14.6	14.6	--
Automatic data processing	32.0	24.6	23.8	- .8
Facilities services	94.3	85.9	85.0	- .9
Technical services	20.5	17.4	16.9	- .5
Administrative support	45.1	42.0	41.1	- .9
 TOTAL	 <u>\$639.3</u>	 <u>\$648.3</u>	 <u>\$650.9</u>	 <u>\$+2.6</u>


 The single reason for the increase in the Research and Program Management appropriation over the Fiscal Year 1969 level is the cost associated with the conversion of support functions to civil service operations at the Goddard Space Flight Center. The 1970 budget provides for the full year cost of the 559 civil service positions established for this purpose in Fiscal Year 1969 and also provides for the cost of the 251 positions required during Fiscal Year 1970 to complete the conversion. This cost has been offset by a corresponding reduction in

the Research and Development appropriation for the portion of the contracts that had been included in that appropriation. Without the transfer of funding for these services from the Research and Development to the Research and Program Management appropriation, the Fiscal Year 1970 request under the Research and Program Management budget would have been \$645.5 million as against a Fiscal Year 1969 total of \$646.7 million.

As indicated previously about 72% of our budget request is planned for payment of salaries, benefits, and associated costs. The personnel category includes all costs related to our civil service complement, such as regular salary for permanent and non-permanent positions; overtime and holiday pay; the cost of personnel detailed to NASA; the cost of the government's share of employee benefits; travel to duty stations and the expenses of moving; workmen's compensation; the cost of personnel security clearances; and employee training.

The permanent personnel strength is planned at 31,600 at the end of Fiscal Year 1970 -- a reduction of 145 from the 31,745 at the end of Fiscal Year 1969. The reduction of 145 positions represents a reduction of 452 throughout the Agency with an offset of the 251 positions for the remaining conversion of support service contracts and an addition of 56 positions at the Electronics Research Center to attain a minimum staffing level.

Travel

The travel category of our budget includes the cost of transportation, per diem, and incidental costs for the travel of NASA employees in carrying out the NASA program. As in the past, about three-quarters of

our travel is directly related to direction, coordination and management of R&D and CoF programs, flight mission support and overseas travel to tracking and launch sites. The remainder of the cost is for participation in meetings and technical seminars and for travel and coordination of general management functions. The total travel estimate for Fiscal Year 1970 is \$14.6 million, about the same as in Fiscal Year 1969.

Automatic Data Processing

The automatic data processing category in Research and Program Management provides for the lease, purchase, maintenance and operations of general purpose equipment which support overall operations common to research and development programs, facilities and business administration. The Research and Development and Construction of Facilities appropriations provide for the automatic data processing systems and operations which are dedicated to specific programs or projects or are included in specific program facilities. In addition, large computer complexes consisting of several systems which are primarily designed for use in direct support of R&D activities and are to be acquired over a period covering more than one fiscal year will be funded under the Research and Development Appropriation. The distribution of ADP equipment by funding appropriation is included in Volume I of the Fiscal Year 1970 budget estimate.

We are requesting \$23.8 million in the Research and Program Management appropriation in Fiscal Year 1970 -- a reduction of \$.8 million from the Fiscal Year 1969 plan. The reductions, in the main, result from reduced lease costs of \$.6 million and reduced programming

and operating services of \$.2 million. These reductions are largely the effect of the release of older equipment with the installation of third generation equipment, and the reduction of the overlap in software costs while programs were being developed for the third generation equipment.

Facilities Services

The fund requirement for facilities services is the second largest increment of the Research and Program Management appropriation. The costs included in this category include general operating and maintenance expenses of the NASA physical plant. The largest part of the costs are in direct support of the research and development programs. For example, the utilities for operating our laboratories, wind tunnels, and research facilities are included. Also included are rental of facilities, alteration, repair and minor construction, maintenance and related services for our buildings and equipment, and operation of our facilities. We have included in this category the entire cost of the range operations contractual effort at the Merritt Island Launch Area and the reimbursement to the Air Force's Eastern Test Range for general services provided to the Kennedy Space Center funded from this appropriation.

For the total facilities services category, the estimate of \$85 million in Fiscal Year 1970 is \$.9 million less than for Fiscal Year 1969. The decrease is primarily related to reductions at the three Manned Space Flight Centers, totaling \$1.6 million, of which the largest individual reductions are \$.5 million at MSC because of a

reduction in the level of activity at the White Sands Test Facility and \$.5 million at the Kennedy Space Center resulting from the phase down of Saturn IB launch activity at Launch Complexes 34 and 37 and related facilities at the Cape Kennedy Air Force Station. These savings are partly offset by an increase of \$.8 million associated with operations at the Electronics and Ames Research Centers. At ERC, additional funds are required to move into new, permanent facilities at the Electronics Research Center and for the operation and maintenance of these facilities. At Ames Research Center, funds are provided for increased electricity usage for wind tunnels and a better level of maintenance and custodial services. The other centers plan a net decrease in this area.

Technical Services

The support to the direct program effort which is funded from Research and Program Management includes certain categories of technically oriented services. These have been grouped together under the category of Technical Services, with subcategories of Engineering Services and Scientific and Technical Information and Education programs.

Engineering services include the cost of reliability and quality assurance training, the preparation of guidelines for reliability requirements and methods, and special engineering designs and studies. The scientific and technical information programs provide for the support of installation technical libraries, the acquisition and

dissemination of scientific and technical literature. The estimate for Fiscal Year 1970 is \$16.9 million, a reduction of \$.5 million from Fiscal Year 1969.

Administrative Support

The remainder of our Research and Program Management appropriation can be described generally as administrative support. The cost of the support provided under this category amounts to less than 7% of the total appropriation level. The estimate for Fiscal Year 1970 is \$41.1 million, \$.9 million less than in Fiscal Year 1969.

The largest part of this category is the cost of administrative communications, including cost of leased lines, long distance tolls (both through the Federal Telecommunications System and commercial), local telephone exchange services, and other communications costs such as TWX, telegraphic services, and postage.

The balance of the costs relate to overall installation operations and include administrative printing and reproduction, supplies, materials and equipment, transportation, and administrative support services, such as medical, supply and mail and messenger services. The reduction in the cost for this total category of \$.9 million in Fiscal Year 1970 as compared with FY 1969 results from the continuation into Fiscal Year 1970 of the concerted effort on the part of NASA installations to reduce their administrative costs to the lowest possible level.

To summarize this area of my presentation, I believe it is apparent that NASA has made major reductions in the Research and Program

Management budget. We are convinced that our Fiscal Year 1970 budget request is as low as is possible and that any further reduction would seriously hurt our ability to carry out the programs requested. By NASA's reliance on industry and universities to carry out most of the research, development, and operations work involved in the aeronautics and space program, NASA has kept its staffing requirements down to the minimum levels necessary to carry out the essential government functions with minimum variations even over periods of fluctuating work activity. This includes the use of support contracts with industry to carry out certain of those functions at NASA installations that do not compromise the basic NASA requirement that government employees must be responsible for the major decisions, specification of goals, evaluation of program status and contractor performance, selection of methods of carrying out the work, and overall management. We believe that this has been an effective operating system but that we have gone as far in this direction as it is wise to do and that any further reductions in civil service manpower beyond those indicated in the budget before you will seriously hurt our ability to successfully accomplish our program and will greatly diminish the national resource of competence provided by these people and our inhouse facilities.

University Programs

I would like now to turn to our programs with universities, which continue to be an essential partner, with government and industry, in the aeronautics and space effort. They have done much to advance our understanding of the space environment. They have trained thousands of men and women. University scientists and engineers have undertaken research in campus laboratories; they have provided over 50 percent of our flight experiments and have published almost 75 percent of the space science reports. This relationship with universities has been essential to the accomplishment of NASA's mission and has been equally beneficial to the universities. NASA has benefitted from the space experiments, the new scientific concepts and the new technologies developed by universities; university professors and graduate students have benefitted by their participation in the acquisition of new knowledge from space research.

NASA's university program has two parts: (1) project-oriented grants and contracts awarded by our program offices and field centers to get university help in accomplishing the ongoing NASA research and flight projects, and (2) grants made under the NASA Sustaining University Program to aid universities in developing their own strengths while undertaking research on NASA's longer range educational and research goals. The Sustaining University Program, therefore, provides a means for drawing on the full capabilities and originality of the universities in NASA's future activities.

About 200 universities in all the states participate in the NASA program. There are about 1300 project-oriented research grants and contracts now in effect which, in Fiscal Year 1969, amount to almost \$100 million per year. Under these grants and contracts, for example, 32 universities in 20 states are now working with NASA on various aspects of the earth resources satellite program. Eighteen universities are working on 51 experiments for the Orbiting Geophysical Observatory (OGO) satellite program. Forty-six universities in 23 states are working on materials technology, and 47 universities in 23 states are working on flight medicine and biology. Over 900 university experimenters are now working on preparation of the experiments or on analysis of data from NASA's balloon, sounding rocket and satellite and deep space flights. One hundred thirty-four (134) principal scientific investigators and 182 co-investigators from 42 universities are preparing to analyze lunar samples to be returned from the moon by the Apollo astronauts. The university participation in this project work has indeed been essential in successfully accomplishing our mission objectives.

In addition, through the Sustaining University Program, we have tried to encourage the development and application of university capabilities to permit even more effective participation in our aeronautics and space science and technology research activities in the future.

From 1959 through Fiscal Year 1968 about \$204 million (about 30% of NASA's total funding at universities) has gone into research, training and facility grants made under the Sustaining University Program.

Between Fiscal Years 1963 and 1968 NASA made 37 facility grants to 34 institutions contributing \$44 million which represents about half the costs of new aerospace facilities at these institutions. In Fiscal Year 1968, 50 universities were being supported under NASA sustaining research grants. With the reduced budget levels available, only 30 of these universities will be awarded additional funds in Fiscal Year 1969.

NASA has awarded a total of 5400 three-year predoctoral training grants; nearly 1700 trainees have already received their Ph.D.'s. The original intent of this program was to help to replenish the national supply of Ph.D.'s by producing 1000 new Ph.D.'s per year. Funding limitations made it necessary to reduce the number of new traineeships in Fiscal Years 1968 and 1969 to 45 per year, concentrating in the public administration, management, and engineering systems areas. In addition to the 45 new predoctoral traineeships that are provided in our Fiscal Year 1970 budget, we are now arranging for about 140 universities to use training funds that were previously obligated to them, but were not expended, to support about 250 additional predoctoral students beginning with the Fall 1969 semester.

Our Fiscal Year 1970 request for the Sustaining University Program is \$9 million, the same as in Fiscal Year 1969. We plan to continue on-campus multidisciplinary research at a reduced level; we will continue to encourage close working relationships between universities and our NASA field centers and will try to make NASA facilities available for

greater use by university professors and graduate students; we plan to continue our pilot research and training programs in public administration, management, and engineering systems design.

Under the present fiscal constraints, we feel that our current plans provide only a holding action that takes advantage of step funding stability in existing grants, stretching out some programs and limiting new opportunities. This is, at best, a temporary solution to both NASA's and the universities' need for long range stable support in research and education. We are concerned that under this plan, we will be unable to meet our long range needs for highly trained people in specialized areas such as remote sensing, lasers and optics, aeronautics, and acoustics. We are now deferring many opportunities to support imaginative and innovative university programs and encourage the building of new capabilities in regions and institutions where the potential now exists. Because of these severe limitations, we are working, within our total budget availability, to find ways of increasing our university support for training and research during the remainder of Fiscal Year 1969 and in Fiscal Year 1970.

The Sustaining University Program will be discussed in detail by Mr. Francis B. Smith, Assistant Administrator for University Affairs, in his testimony before the House Subcommittee on Space Science and Applications and he is available here if the Committee wishes to have him comment on any specific issues in this area.

Technology Utilization

The Technology Utilization Program is an experimental program designed to explore and develop practical ways of transferring new aerospace technology to such diverse non-aerospace fields as law enforcement, education, air and water pollution, health care, automotive and aircraft safety. By encouraging the additional uses of aerospace technology in such non-aerospace fields, an additional return may be realized on our investment in aeronautical and space activities. We believe that the original program assumptions are validated by the transfer of new technology in an increasing volume to non-aerospace industry, universities and other users.

The President's budget for Fiscal Year 1970 requests \$5 million for the Technology Utilization Program; the same amount as was authorized in Fiscal Year 1967 and an increase of \$1 million and \$1.2 million over the amounts authorized in Fiscal Year 1968 and 1969, respectively. The increase of funds will provide for increased effort to develop specific new technology identification techniques and methods which will serve to accelerate and increase the identification and reporting of significant NASA developments in such important areas as computer software and advances in biomedical instrumentation with a high potential of further applications.

The Technology Utilization Program now has in operation six university based Regional Dissemination Centers transferring aerospace

technology to industrial clients; three research institute based multidisciplinary Biomedical Applications Teams transferring aerospace technology directly to biomedical researchers in medical institutions, and a Computer Software and Management Information Center disseminating and transferring directly to industry computer programs developed by NASA and the Department of Defense. These existing dissemination and transfer mechanisms will be expanded to allow them to capitalize on new opportunities to transfer knowledge to new users.

We are currently cooperating with the Department of Defense by making available to industry NASA and DOD computer software through the Computer Software and Management Information Center and the unclassified technical data on magnetic tapes at the Defense Documentation Center through our Regional Dissemination Centers. In order to achieve overall economies, we are working jointly with the Atomic Energy Commission to make available, through our Technology Utilization publications, the AEC's technical innovations. We recently concluded final arrangements to provide the services of one of our Technology Applications Teams to the National Air Pollution Control Administration to assist them in identifying air pollution problems which may be solved by aerospace technology and then systematically searching the aerospace data bank for solutions to those problems. The Applications Teams are also working closely with the Social Rehabilitation Service to apply aerospace technology to solution of medical problems. In a cooperative program with the Law

Enforcement Assistance Administration the NASA Applications Team at the Research Triangle Institute in Durham, North Carolina, recently completed a police personnel communications systems study based on aerospace communications technology. We are planning additional interagency cooperative efforts with other agencies, such as the Federal Water Pollution Control Administration, the Department of Transportation and the Department of Housing and Urban Development to use the basic transfer mechanisms and capabilities that NASA has developed and funded. This will allow the matching of technical problems identified by those agencies with aerospace data in order to achieve possible solutions to those problems.

The Technology Utilization Publications Program is being strengthened to insure that significant new technological developments are documented and made available to industry and universities. Nearly twenty highly significant technical documents on such subjects as non-destructive testing, bioinstrumentation, and application of systems analysis models were published last year and it is anticipated that nearly twenty-five more will be published this year.

We believe that these approaches do offer real opportunities for added benefits and "return on our investment" from our aerospace programs.

The transfers of aerospace knowledge to other fields are numerous but I would like to cite a few as particular examples. Infants or comatose children or adults sometimes require a tracheotomy tube

surgically implanted in the windpipe to ease breathing. If the tube clogs -- which it often does -- cutting off breathing, brain damage or death can result in two to four minutes. A full-time nurse is required to check the tube visually. Integrated circuitry designed and fabricated for aerospace use by NASA Ames Research Center has been modified to note differences in temperatures of air passing through the tube and actuate an audible or visible alarm within 10 seconds of any change. The signal can be given at a nurse's station or in another room if the patient is at home.

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Aerospace technology may play a part in reducing radiation hazards for those patients who must be treated with radioactive iodine. An iodine isotope, iodine 123, may reduce the radiation dose, when used with the proper equipment, by a factor of almost 10,000. The isotope would replace the reactor-produced isotope iodine 131. Cost of preparation of the iodine-123 had limited its use in diagnosis and treatment. Now, an economical method for its preparation, developed by the Lewis Research Center in conjunction with the Department of Health, Education and Welfare, has been developed. The details concerning the method were summarized in a Technology Utilization publication.

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A management technique called "Vis-A-Plan" used to maintain control over engineering and development projects and some production activities was developed by an aerospace company for Kennedy Space Center and has been adapted by a small business. The company employs

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600 persons, performs work for a variety of customers, and has adapted the Kennedy program to manage and control engineering projects where there had been problems with cost and time overruns. The only staff time required, according to the company, is that of a clerk who posts the results and the data received. Called "a tool we can trust" by the division manager, the plan has speeded engineering output, and has cut costs by 10 percent. The company learned of the charting method through a Technology Utilization publication.

A NASA-developed technique for detecting voids or poor bond lines in fiberglass laminates is of interest ⁽⁴⁾ to widely varying industries. The procedure is to apply a thin coating of a commercially available liquid crystal solution. When the sample is heated, defect locations are shown by differences in color due to variations in heat. A chemical firm believes that production of resistant coating should be improved when the technique is perfected for its use. An electronics firm is adapting the method to its fiberglass laminate production for circuit-boards. A brake manufacturer reports the method to be potentially valuable in its work. A helicopter maker is evaluating the procedure for testing the integrity of bonded panels. And a building products maker believes the technique can be used to monitor the quality of wallboard during the manufacturing process; there had been no satisfactory method of determining the distribution of voids within wallboard.

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These examples have been related to illustrate a very important experimental process which is going on to generate the bonus returns on our involvement in aeronautics and space programs.

Dr. Richard L. Lesher, the Assistant Administrator for Technology Utilization, will be describing this program in detail in the hearings before the Subcommittee on Advanced Research and Technology and he is also available here to take part in any discussion of this area that you may desire.